Aquarius Time Series

Guide / User Manual

Instructions

This software was developed using Matlab 2014a. In order to run this software, you should at least have the 2014a version (no guarantee that is will work on later versions).

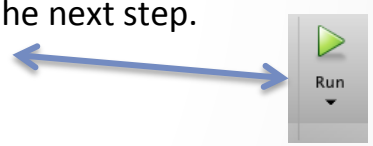
To run the Aquarius Time Series Application:

-*Double click* on the **Run.m** file located in the Aquarius folder. This will trigger Matlab to open.

-*If there are not enough available licenses on the network, then Matlab will throw an error window. If this happens, simply try again later when there are less JPL employees using Matlab.*

-Once Matlab is open and the code is showing, there are two ways to complete the next step.

Click the '**Run**' button *(located in the editor toolbar at the top)*



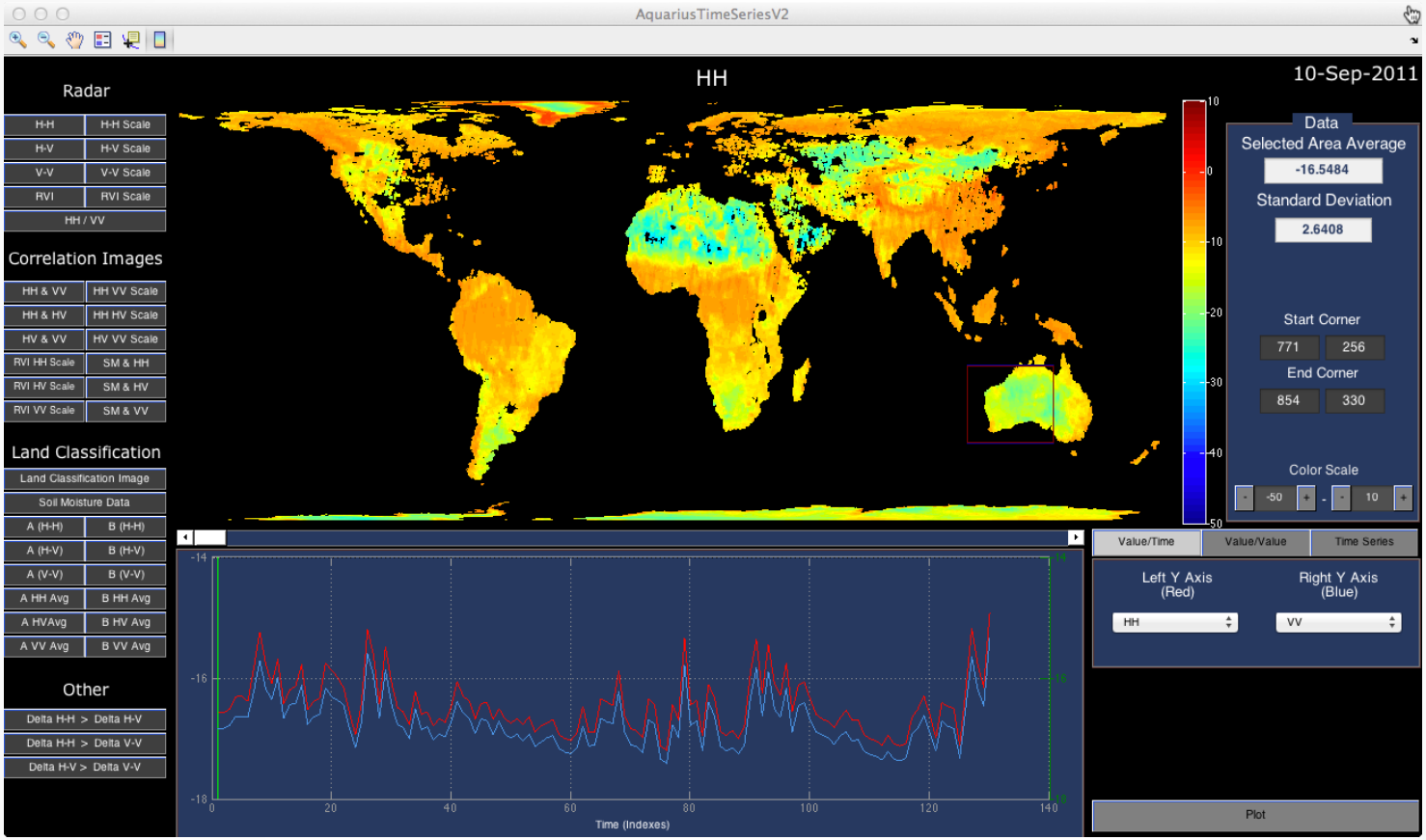
OR

Type **Run** in the command window, and press Enter.

-Matlab might ask you to change to the correct folder. If it does, click ***Change Folder/Accept***

-The program will then run. A loading window will inform you that the data is being loaded into the workspace. Once it is finished loading the data, the application will be displayed.

Layout

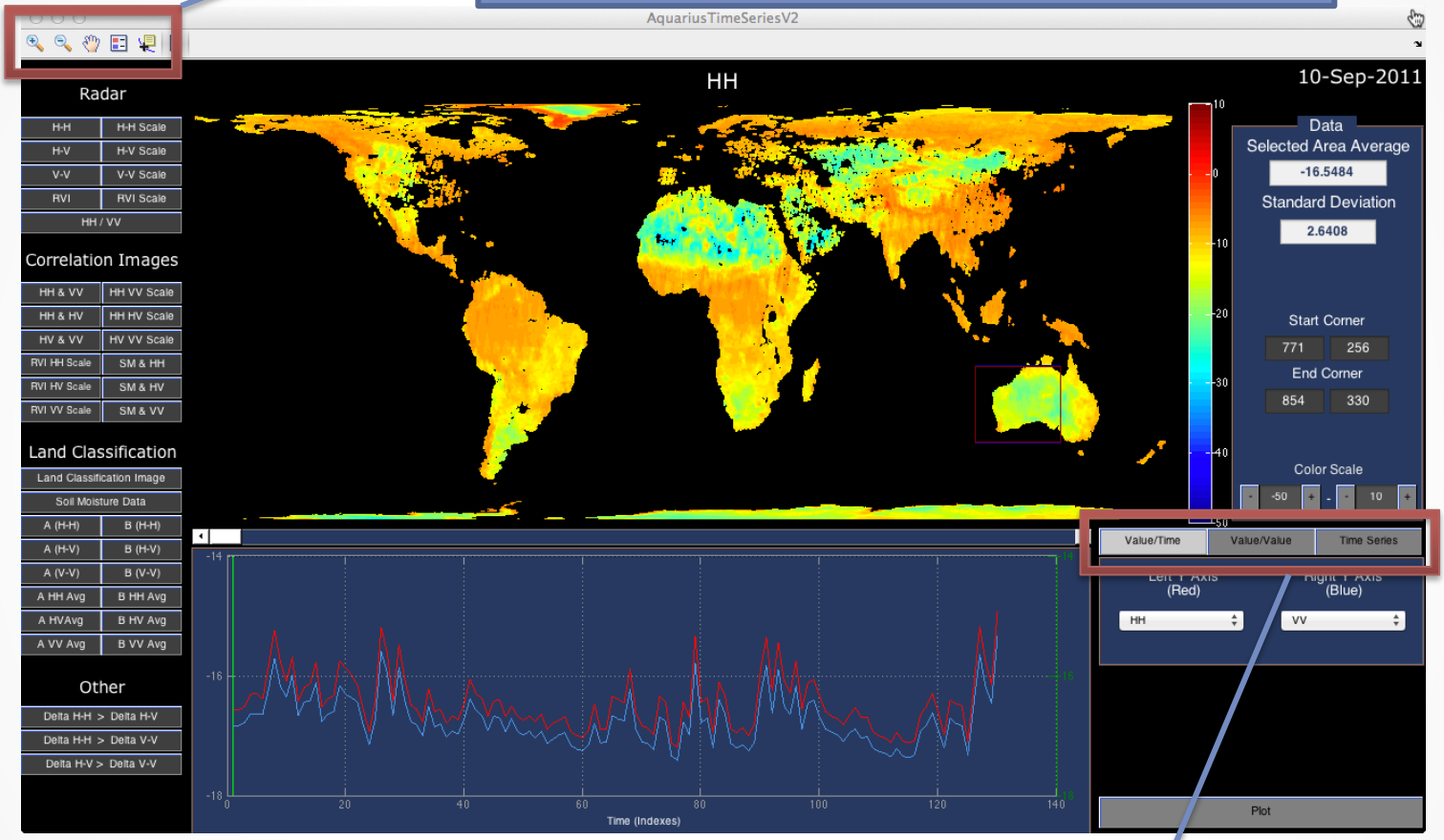


The purpose of this program is to help display and analyze radar data from the Aquarius Satellite.

Layout

The Toolbar – 5 buttons

Zoom in/Out : For viewing smaller areas in larger detail
Hand Tool: For moving the image while zoomed
Legend Button: View a legend for the data on the plot axis
Data Cursor Mode: Selecting this button will display the X & Y values when you select points on the data plot



Plot Type Selection buttons - 3 Buttons

Value/Time : Select this panel to view Two data sets as they change over time. There are two axes, one on the left, and one on the right. The blue data is for the right axis, and the left axis is for the red data. Select what you would like to see in the panel
Value/Value: Plot one data set vs. another data set. Ex (HH vs. Soil Moisture).
Time Series: Run a time series simulation

Layout

Data Display Panel

-Displays what pixel, or area of pixels, you have selected to view *(2 different pixels will give two opposite corners of a selected area).*

-Displays the single value (or mean average value & standard deviation) of a selected pixel (or selected area).

-Displays the corresponding date for the image displayed *(changes with every new image, where each new image is a new week).*

-Change color limits of the image

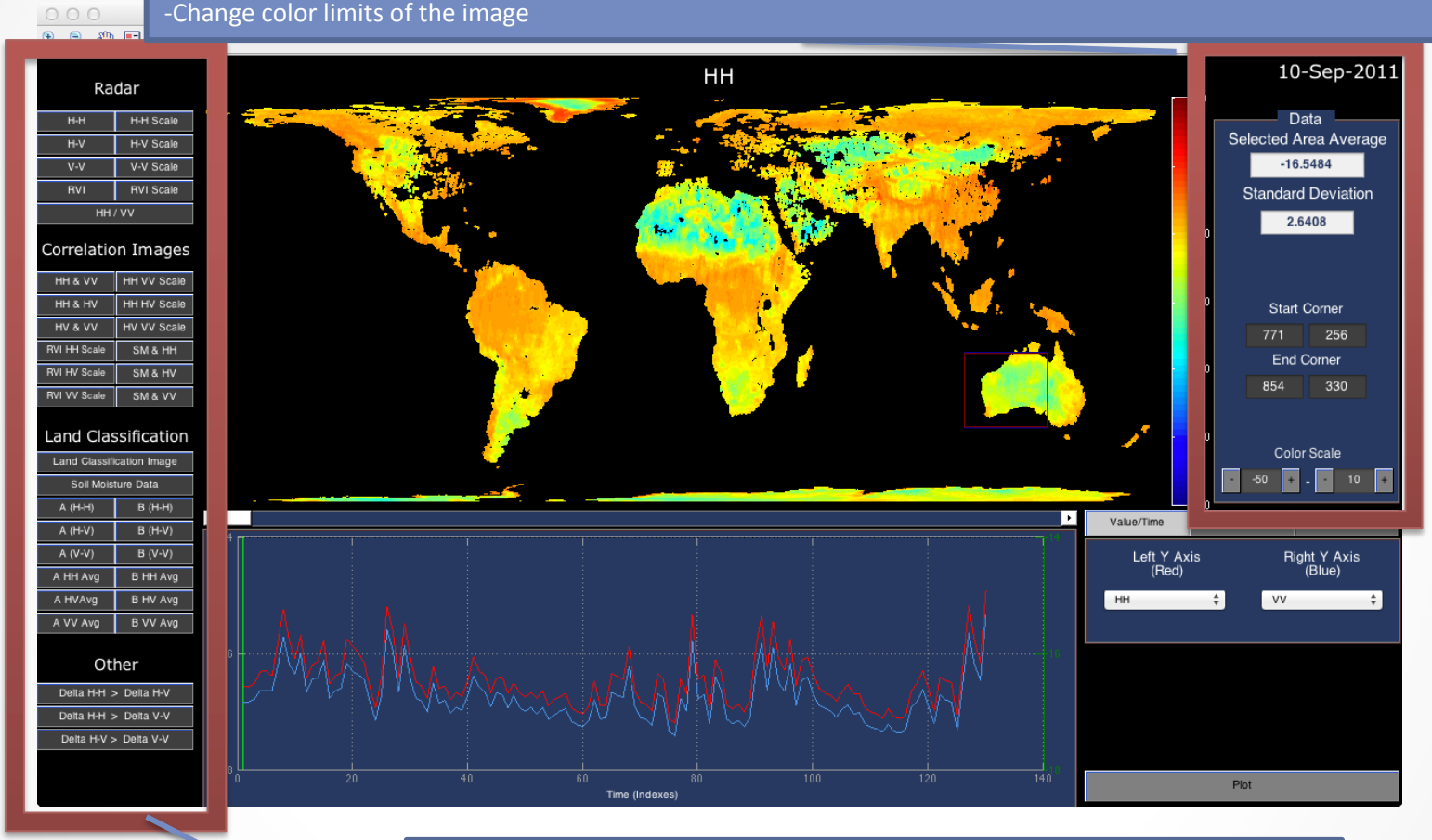


Image Type Selection Buttons

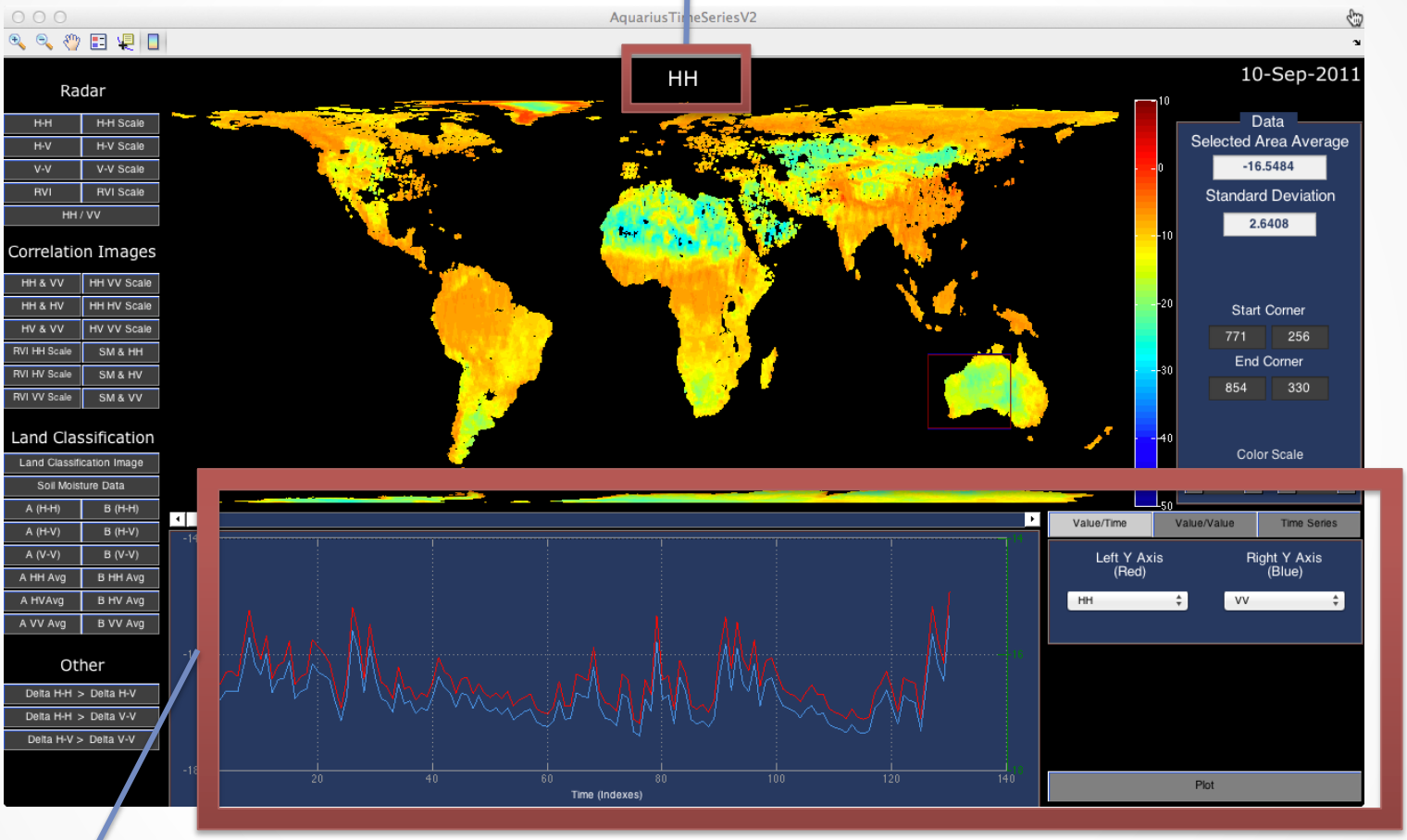
-Here, you can select what type of data you would like to view. Choose from viewing raw radar data, correlation of two different radar types, or land classification parameter images.

-See the Data Description slides for more details about each data type, and how the the data was developed.

Layout

Title

Displays what data type you are currently viewing

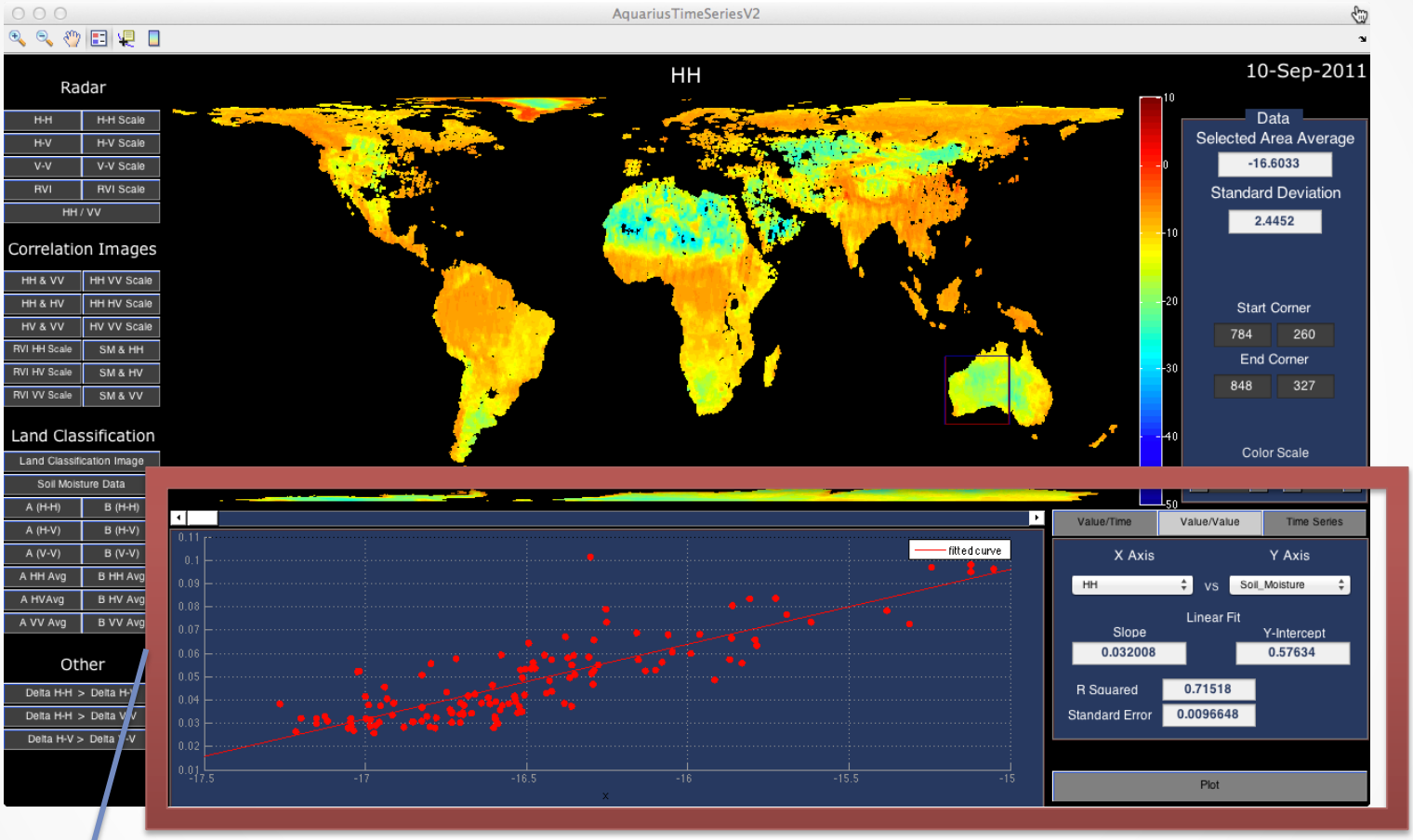


Plot and View Options

-Here is where you can view a plot of how the selected point/area changes over time.

-The view options Check boxes is where you Select what type of Plot you would like to see. (value vs. time, or value vs. value)

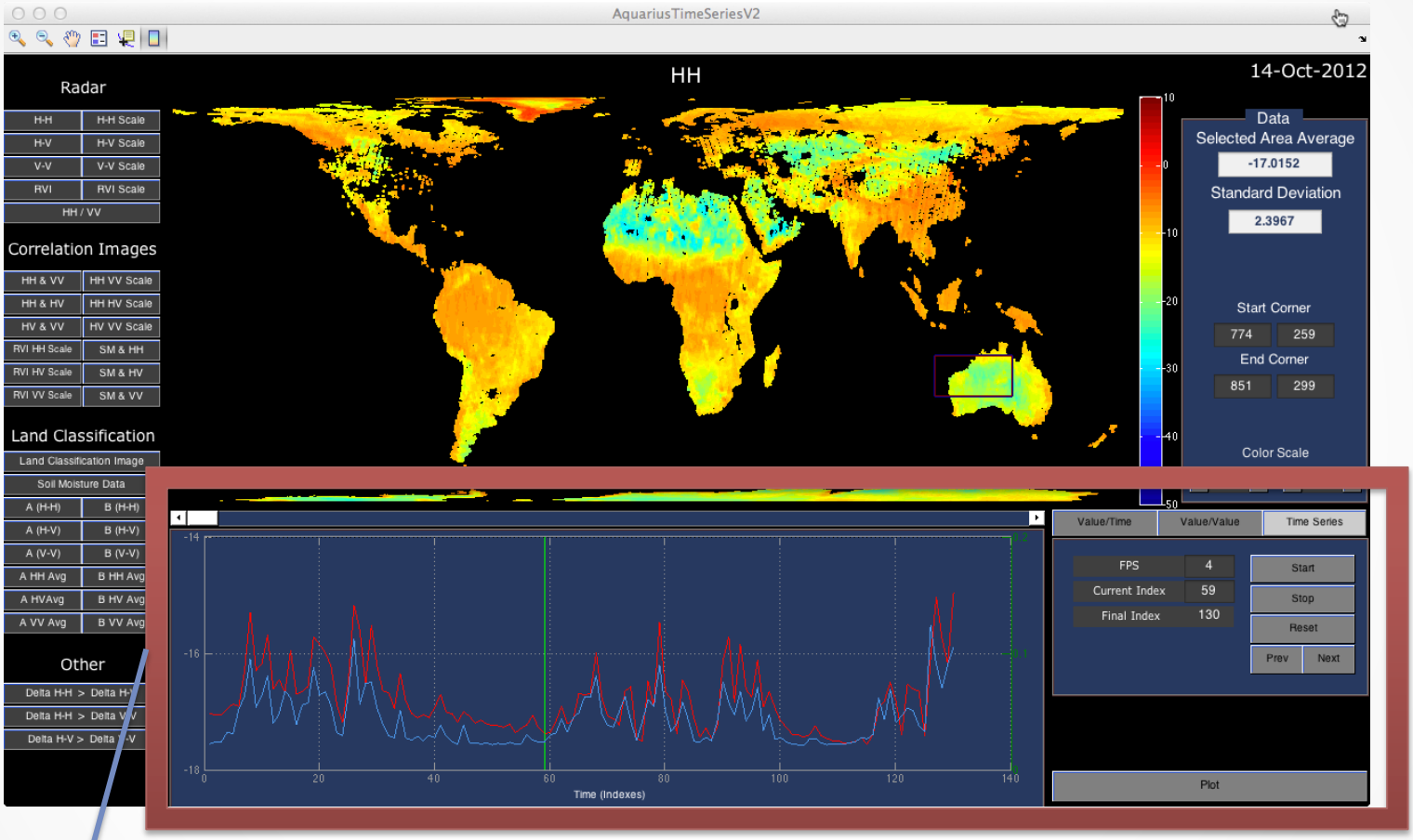
Layout



Value vs. Value

-Here is an example of a value vs. value plot.
-Plots the averages of the selected area.
-The right options is where you can select what two data combination to plot, and view the linear trend of the output.

Layout



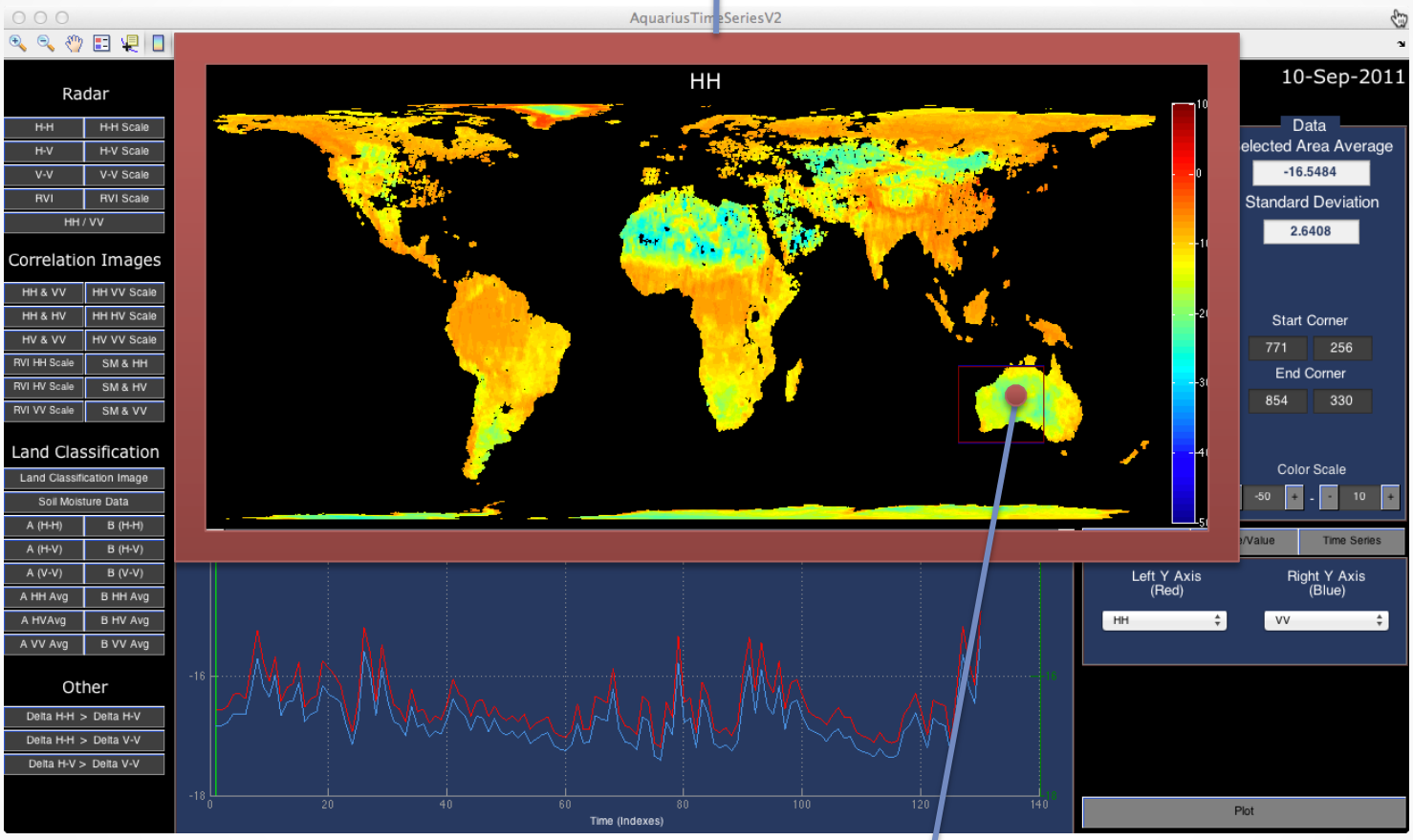
Time Series

-Here is an example of a time series option.
-The green line on the graph represents the current image index. Click on the graph to go to specific indexes.
-Click Next, or the right slider bar to move to the next image.
-Click Prev, or the left slider bar to move to the previous image.
-Start and stop control a time series simulation that changes image indexes with the rate set in the FPS box.

Layout

The Main Image

-Displays the selected data type at the current index.
-Displays a color bar on the side to visualize the data scale.
-Slider on the bottom to move from slide to slide.



Clicking on the Image – 2 options

Click : Selects the pixel you clicked, displays that pixels value in the data panel, and plots that point's values.

Drag and Drop: Selects an enclosed area of pixels, displays the mean average and STD of the area (excluding ocean) in the data panel, and plots that areas average values.

Data Information

The data that gets loaded into the application is stored as a .mat file. The reason for this is to can keep all the data and variables in one location. Computing them all at once saves time and leaves less work for the application.

The Data is saved as **AquariusWeeklyData.mat**. It contains several series of 130 images
- (Sept, 2011 –> Feb, 2014, @weekly intervals). Each image has the dimensions 406x964.

AquariusWeeklyData.mat contains the following:

Radar Polarimetry
- HH
- VV
- HV
- RVI
- HH Wetness Parameter/Scale
- HV Wetness Parameter/Scale
- VV Wetness Parameter/Scale
- RVI Wetness Parameter/Scale

Correlation Images
- HH & HV Correlation
- HH & VV Correlation
- HV & VV Correlation

- HH & HV Scale Correlation
- HH & VV Scale Correlation
- HV & VV Scale Correlation

- RVI & HV Scale Correlation
- RVI & VV Scale Correlation
- RVI & VV Scale Correlation

Land Classification
- Sample Land Classification Image
- Soil Moisture data (SM)
- A & B values (From HH & SM, every 6 images)
- A & B values (From HV & SM, every 6 images)
- A & B values (From VV & SM, every 6 images)
- A & B Avg values (From HH & SM, Entire series)
- A & B Avg values (From HV & SM, Entire series)
- A & B Avg values (From VV & SM, Entire series)

Other
- ΔHH > ΔHV
- ΔHH > ΔVV
- ΔHV > ΔVV
- HH / VV
-BadData *(to keep track of bad data & ocean locations, not visible)*

Data Info

Radar Polarimetry

The Radar data (HH, HV, VV) is a 3D array with the dimensions 406x964x130, representing 130 pictures with the resolution 406x964.

- Scale is from -50 -> 10.
- Data is in db

The Radar Vegetation Index data (RVI) is 406x964x130. *(Normalized HV)*

- Scale is from 0-1
- Data is linear
- Each pixel's value is obtained from the following equation:

db->linear before computing

$$RVI(x, y, t) = \frac{8 * HV(x, y, t)}{HH(x, y, t) + VV(x, y, t) + 2*HV(x, y, t)}$$

The Wetness Parameter / Scale data (HH Scale, HV Scale, VV Scale, RVI Scale) are 3D arrays with the dimensions 406x964x130, representing 130 pictures with the resolution 406x964.

- Scale is from 0 - 1
- Data is Linear
- Each pixel's value is obtained from the following equation:

$$HHParameter(x, y, t) = \frac{HH(x, y, t) - Min(HH(x, y, :))}{(Max(HH(x, y, :)) - Min(HH(x, y, :)))}$$

: = iteration through entire data

Data Info

Correlation Images

The **Correlation Images** are single images that display each pixel's correlation between two types of data, over the whole time span (130 images, 2 years)

- Scale is from 0 -> 1
- (406x964x1)

Example (HH & VV Correlation)
For each pixel(x, y)

$$CorrHHVV(x, y) = corr2(HH(x, y, :), VV(X, Y, :))$$

corr2 *is a built in Matlab function from the image statistics toolbox*
: = iteration through entire data

Correlation Images

- HH & HV Correlation
- HH & VV Correlation
- HV & VV Correlation

- HH & HV Scale Correlation
- HH & VV Scale Correlation
- HV & VV Scale Correlation

- RVI & HV Scale Correlation
- RVI & VV Scale Correlation
- RVI & VV Scale Correlation

- HH & SM Correlation
- VV & SM Correlation
- HV & SM Correlation

Data Info

Land Classification

Soil Moisture data (SM)

- Data originally in Lat/Long coordinates(180x360).
  - *-smap2ease function to transform to 406X964 grid, hence the lower looking resolution*
- Scale is from 0-1,
- Data obtained from http://nsidc.org/data/AQ3_WKSM

Bindlish, R. and T. Jackson. 2013. *Aquarius L3 Gridded 1-Degree Weekly Soil Moisture.* Version 2. Boulder, Colorado USA: NASA DAAC at the National Snow and Ice Data Center.

Land Classification Sample Image

- Sample image of past land classification.
  - *-smap2ease function to transform to 406X964 grid*
  - *-Last slide of this guide will show the scale and classification types.*

A & B Land Values (*A(HH), B(HH), A(HV), B(HV), A(VV), B(VV), and series averages.*)

- A and B values represent constants that are common among each terrain type
- A and B images are 3D arrays with the dimensions 406x964x130, but each image is repeated 4 times (*32 different images)*
- Each pixel's value is obtained from the following equation:

For every 6 images, (and entire series for averages)

```
temphh(1:4,1) = HH(x, y, 1:4);
tempsm (1:4,1) = SM(x, y, 1:4);
f = fit(temphh, tempsm, 'Poly1');      %Linear least square fit 6, pixels in time
HHA(x, y, 1:4)  = f.p1(1);             %Slope
HHB(x, y, 1:4)  = f.p2(1);             %Y- Intercept
```

: = iterate through the range

Data Info

Other

Delta Data (ΔHH, ΔHV, ΔVV)

- An array of values (406x964x129) where each point is the difference in value between the current image, and the next time image
- *Only visible in the plot*

Delta Images (ΔHH>ΔHV, ΔHH>ΔVV, ΔHV>ΔVV)

- Creates an image while looking at the difference between two Δ data types.
- 406x964x1
- Each pixels value is obtained from the following equation:

For each pixel
For t=1:129

```
if ΔHH(x, y, t)  > ΔHV(x, y, t)
        DHHDHV(x, y) += 1;                  %Increment the current value
else
        DHHDHV(x, y) -= 1;                  %Decrement the current value
```

HH / VV

- An array of images generated by dividing a pixels HH value by the corresponding VV value.
  - *-Division in linear scale is equal to subtraction in logarithmic scale.*
- 406x964x130

(linearly scaled example)
For each pixel & image

```
HHVV(x, y, t) = HH(x, y, t) / VV(x, y, t);
```

Other Information

Other functions:

LoadData	- Reads raw data, and creates the datasets previously listed
LoadNewFiles	- Loads the path and filenames of the raw data
smapease2forward	- Convert between different grids
smapease2inverse	- Convert between different grids
maxCustom	- A custom max function that ignores when a value is bad data
minCustom	- A custom max function that ignores when a value is bad data
custlinfit	- A custom linear regression fit function for faster computation.

-For more information, view the code file.

Contact

Any questions or issues, please contact

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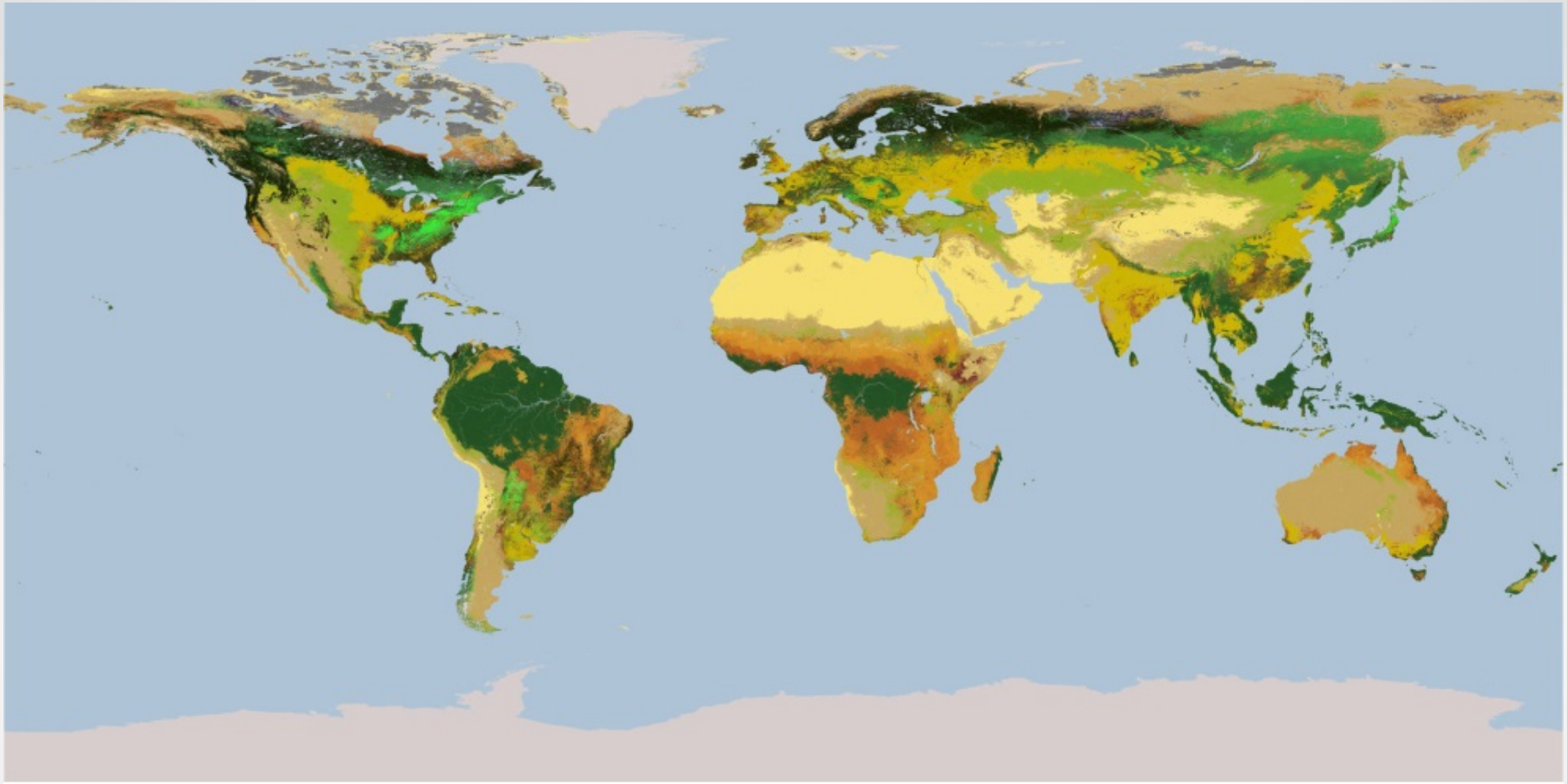
0 Water
1 Evergreen Needleleaf Forest
2 Evergreen Broadleaf Forest
3 Deciduous Needleleaf Forest
4 Deciduous Broadleaf Forest
5 Mixed Forests
6 Closed Shrublands
7 Open Shrublands
8 Woody Savannas
9 Savannas
10 Grasslands
11 Permanent Wetlands
12 Croplands
13 Urban and Built-Up
14 Cropland/Natural Veg. Mosaic
15 Snow and Ice
16 Barren or Sparsely Vegetated
17 Tundra